It may curve outward, lying lateral to the line between the middle of the ankle and the back of the first interosseous space. Or it may be completely absent, being replaced by a large anterior peroneal artery. Other locations are possible.

Linear measuring of the circumference of the extremities at selected points is a good policy. Where the circulation is deficient, the tissues will be undernourished and atrophied, with a resultant reduction in circumference. Measurements will aid in checking the results of treatment and progress of the disease. These are much simpler to take than surface temperatures and oscillometer readings, and are very important in the study of the disease.

Some of the presumable symptoms of a vascular disorder—as undue tiredness, sensation of heaviness and early fatiguability in the calves, especially in the male—may be due to the onset of the climacteric. In these cases, substitution therapy may be necessary.

Do not inject or operate on a patient for varicose veins unless you are sure that the deep veins are adequate and that the patient is not suffering from a peripheral vascular disease such as thromboangiitis obliterans.

The majority of patients get better on bed rest. It is the best form of treatment and it is surprising what good results can be obtained by this method.

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Hemolytic Streptococcic Meningitis Treated with Sulfanilamide.—Ten of twelve patients with hemolytic streptococcic meningitis treated with sulfanilamide recovered, as compared with one of eleven patients treated with specific drugs and serums, spinal drainage, and blood transfusions, John A. Toomey, M. D., and E. Robbins Kimball, Jr., M. D., Cleveland, report in *The Journal of the American Medical Association.*

Hemolytic meningitis is inflammation of a membrane of the brain and spinal cord caused by a streptococcus capable of destroying or dissolving the red blood corpuscles.

Doctors Toomey and Kimball emphasize the fact that sulfanilamide alone may prolong the life of a patient ill with this type of meningitis, but it will not give complete cure if there is an undiscovered focus of infection. In a few cases in which the focus was not recognized immediately, the progress of the disease was held stationary. There was no cure, however, and improvement occurred only when operations eradicating the infection were performed.

The authors have not found it necessary to adopt the more involved methods used by others, but state that their procedures have given as good results. "Our practice," they assert, "has been to give a massive initial dose of the drug (sulfanilamide) followed at once by frequent maintaining doses, to have the patient operated on as soon as possible for removal of the focus of infection and to leave the fluid balance of the spine alone unless the pressure is extremely high."

A total of 102 cases described in recent literature were treated with sulfanilamide or prontosil, or both, and eighty-one of these recovered.

ORIGINAL ARTICLES

SOME INDICATIONS FOR ROENTGEN RAY TREATMENT*

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PART I

THE indications for roentgen ray and radium treatment are innumerable, volumes having been written on this subject. It will be possible in this paper to give only a broad outline of the usefulness and applicability of these methods of treating different pathologic processes and to discuss a few of them specifically.

Many physicians and surgeons have neither the time nor the inclination to peruse radiologic journals. Therefore, they may not be familiar with the advances made in the technical procedures or the most recently proved indications or benefits which may be derived from irradiation for certain diseases, so they must depend for this information upon conference with their radiologist colleagues.

The medical world has become so statistics-minded that sometimes there is skepticism about the benefits of a therapeutic procedure as compared with others, unless mathematical proof substantiates the effectiveness of a newer method advocated. Definite palliative effects and improvements may be brought about in the economic status of patients by certain methods of treatment, but often cannot be calculated by any mathematical formulae. So it is with irradiation, which has proved to be of so great value in the treatment of many pathologic conditions that it no longer needs defense, although sometimes its benefits cannot be measured.

There was a time, not many years ago, when there was confusion in the minds of radiologists and disagreement about the indications or preferences for either roentgen ray or radium in the treatment of various conditions. Differences of opinion lead to progress, however, and experience and experiment prove that both the roentgen ray and radium have their own spheres of usefulness; that the rays have the same physical and biologic effects; that the use of either or both depends largely upon availability, the ease of application, or whether treatment must be given to small or large areas. The biologic reactions to both types of rays depend upon their power to modify or completely destroy cellular functions, according to the quantity and rate of administration. Each may be effectively employed alone for different and similar pathologic conditions, and more often in combination, or sometimes to supplement surgical procedures either before or after operation.

It may be said, in general, that roentgen ray and radium treatment is indicated and useful (1) for some benign tumors; (2) for most malignant tumors; (3) for many acute and chronic inflammatory processes; (4) for certain diseases that have not yet been proved to be either inflammatory or

* Guest Speaker's paper. Read before the third general meeting of the California Medical Association at the sixty-eighth annual session, Del Monte, May 1–4, 1939.

neoplastic; and (5) to modify glandular functions that are abnormal.

It is not my purpose to discuss radium treatment except coincidentally; rather, I shall limit my remarks to some of the indications for roentgenotherapy in the hope of stimulating interest in the investigation of the application of this method of treatment for pathologic conditions in which it has not been tried or has failed—possibly because techniques which had been employed were faulty. No statistics will be presented, technical procedures will not be discussed, nor will the use of roentgenotherapy in dermatology be given consideration.

BENIGN TUMORS

Irradiation is indicated for but few benign tumors, because most of them are composed of highly differentiated tissues that approach normal; therefore, they are relatively resistant to the direct destructive effects of the rays. However, there are some that are especially amenable to irradiation, among them being hemangiomas in any location and especially those of children, endometrial transplants, fibromyomata of the uterus, papillomas in certain locations, giant-cell tumors of the bone and certain benign tumors of the endocrine glands, the abnormal functions of which may be modified.

Small superficial hemangiomas that are seen in infants probably are best treated with applications of radium, and it is easier to apply to uncontrollable children. Treatment should be given as early in life as possible. Occasionally quite large hemangiomas occur for which it is impractical to use radium because of their extent. Most of these, in children, may be very successfully treated by roentgen rays. However, those in adults seldom are benefited.

Strictly speaking, endometrial transplants (endometriosis) may not be considered as benign neoplasms. Endometrial tissue may become implanted on the pelvic peritoneum and increase to such an extent that a considerable area may be involved; or they may be quite as circumscribed as a tumor. The condition may result from intra-uterine or ovarian operations, following pregnancy, or endometrial tissue may become implanted by contamination of abdominal wounds when the uterus is opened during operations. At the time of menstruation, transplanted endometrial tissue becomes engorged with blood, just as does the endometrium of the uterus. When this occurs it may cause considerable discomfort from pressure. The condition is successfully treated by stopping ovarian function permanently or temporarily by roentgenotherapy according to individual indications.

The indications and contraindications for irradiation for uterine fibromyomata are now generally agreed upon:

1. When hemorrhage is severe, either hysterectomy or radium treatment are preferred to roentgenotherapy. Radium, when applied within the uterus, has a direct effect upon the endometrium and usually will stop bleeding quite promptly before suppression of ovarian activity or the tumor *per se* is affected. Roentgen treatment stops ovarian function and directly affects fibroid tumors and endometrium, but these reactions are delayed. Usually one menstrual cycle ensues even after adequate roentgenotherapy, and this sometimes may be incapacitating. However, when it is not urgent that the hemorrhage be stopped, then roentgen treatment is preferable because of the ease of application, hospitalization and operative procedures are avoided, and during the course of treatment the patient may carry on her usual activities.

2. Women in the child-bearing ages up to forty should not receive irradiation, but should be operated upon to preserve ovarian function, unless there are contra-indications to operation because of concurrent diseases which would make surgical procedures unduly hazardous.

3. Fibroid tumors that present evidences of marked degeneration should be removed, although the presence of moderate pelvic inflammation does not contra-indicate irradiation for fibroids; in fact, this condition will be benefited if the treatment is given with discretion.

According to the experiences of radiologists, approximately 90 to 95 per cent of fibromyomata that have been irradiated have been clinically cured. Over a period of almost a year, the tumors slowly reduce in size. Sometimes vestiges of the tumor may be found even after adequate irradiation, although the symptoms have been entirely relieved by treatment. This, however, does not indicate that the treatment has been a failure, because the mere presence of the small remnant is of no clinical significance and its removal is unnecessary.

Papillomas of the larynx may recur repeatedly after operations; but, especially in children, they may be treated successfully by roentgenotherapy. Papillomatous tumors or papillomatosis of the urinary bladder also may yield to intensive treatment. We have seen cases in which the distressing symptoms have been entirely relieved and the tumors have disappeared completely.

Many giant cell tumors of bone have been successfully treated. These tumors are primarily benign, but occasionally one degenerates to become malignant. The objective of roentgen treatment is not to destroy the tumor cells, but to inhibit their growth sufficiently to permit normal osteogenic reactions; therefore, the treatment is given in relatively moderate dosages. Overenthusiastic or poorly timed treatment may stop osteogenesis which has developed and defeat the purposes of the treatment. In addition, deforming, unsightly tumors in such locations as in the bones of the lower radius and ulna or the ankle probably should be operated upon primarily, especially in women, because they are accessible and the unsightly tumor mass still may remain after irradiation.

MALIGNANT TUMORS

It would be presumptuous of me to talk here in California about the latest developments in roentgenotherapy for malignant diseases where physicists and radiologists have led the world in laboratory and clinical researches, and have developed apparatus the like of which is available in but few medical centers. When these workers began their investigations in the treatment of malignant

neoplasms, they knew (1) that tissues vary in their resistance or sensitivity to roentgen rays, and (2) that any neoplastic tissue may be completely destroyed by irradiation if a sufficient intensity can be administered without damage to normal, physiologically essential structures. (3) They hoped, also, that they might improve the quality and increase the quantity of radiation that can be administered safely and thereby improve the results. All of you are familiar with their invaluable contributions to the science of radiology.

It would be impossible even to enumerate the indications for roentgen-ray treatment of the various types of malignant tumors in different locations. I believe that, at this time, except for superficial tumors, irradiation is indicated in the treatment of malignant tumors only when there is no possibility of cure by operation or intensive radium treatment of localized neoplasms. There is considerable difference between "operability" and "curability." There are but few locations in the body where malignant tumors occur that operations cannot be performed from the technical standpoints, but this does not necessarily mean that cure may be effected or operations justified. Experienced, conscientious surgeons will not subject patients to surgical procedures if there is no possibility of cure, with the occasional exception of those cases where it is used solely for palliation. The clinical manifestations of "incurability" should be sought and recognized, and patients having them should not be operated upon, but should be treated by irradiation if the physical condition warrants any attempt at treatment. A very large proportion of patients with malignant tumors are "incurable," although operations may be performed upon a great many of them. Such practice should be condemned.

There are some conditions for which preoperative irradiation may be indicated, but probably these are very few. For tumors that offer a reasonable degree of assurance that they can be safely and completely removed, operations offer the quickest and most certain method for cure with some very definite exceptions. Those which present clinical evidences that they are too extensive to be removed completely should be irradiated. If a neoplasm can be completely destroyed by irradiation, operation following the treatment would be useless. When a malignant neoplasm has been irradiated because it is extensive and the treatment fails to eradicate it completely, then it will still be of the same extent after treatment, although possibly of less bulk, and it still would not be removable; therefore, operation at this time also could not effect a cure.

On the other hand, there are many indications for roentgenotherapy following operations, the treatment being given in order to delay or prevent extension of a malignant neoplasm if there is any doubt whatever that it has not been completely removed. This is true in a very large proportion of cases even after what appears to be adequate operations. Irradiation should be given as soon as possible before further extension takes place. It is illogical to wait until recurrences or metastases do develop, as has been advocated, before giving irradiation when there is every indication that malignant tissues remain after operation. Certainly surgeons, themselves, condemn the practice of procrastination in the treatment of cancer, and radiologists should do the same. However, when postoperative recurrences and metastases do develop they may be effectively treated by irradiation for amelioration of distressing symptoms and to prolong life and economic usefulness if possible.

In passing judgment about the benefits of roentgenotherapy for cancer in any location, it should be borne in mind that the results of this treatment for postoperative recurrences or metastases cannot be justifiably compared with other methods of treatment employed for primary tumors. There are not a few reports in the medical literature by individuals apparently unfamiliar with radiological procedure, and in which the results of operation alone for malignant tumors in certain locations are purported to be compared with the results from postoperative roentgenotherapy, and the conclusion is drawn that the treatment has not been of benefit. A careful analysis of the statistics on which this conclusion is based will show that the series of irradiated cases will contain a larger proportion of advanced cases than the nonirradiated and also some irradiated some time after operation primarily for postoperative recurrences or for metastases. Conclusions based upon such inequitable comparisons are not justifiable. As has been mentioned previously, palliative benefits cannot be calculated.

I should like to dismiss the subject of indications for the roentgenotherapy for malignant tumors with the suggestion that the best way to find out about the indications or limitations for any particular case is to consult a competent radiologist.

ACUTE INFLAMMATION

Roentgenotherapy offers a large field of usefulness in acute inflammations in many locations. This treatment usually gives prompt relief from pain, fever often abates, and the natural course of the process may be aborted.

Very soon after roentgen rays were discovered it was theorized that they might be a component of sunlight. Heliotherapy had been used for the treatment of tuberculosis, and sunlight was known to be mildly germicidal. Therefore, cultures of tubercle bacilli and other pathogenic organisms were subjected to roentgen rays, but eventually it was proved that the rays are not directly germicidal. Nevertheless, infectious processes were benefited. Perhaps the best explanation of the effects was given by Dr. Arthur Desjardins. According to his theory the effects are due to the destruction of the particularly radiosensitive leukocytes, especially lymphocytes, that infiltrate about an inflammatory process. It is thought that when phagocytic blood cells are destroyed by irradiation, antibodies and other protective substances which these cells contain are liberated to overwhelm infection. The roentgen-ray treatment of acute inflammation, therefore, requires few and small doses; in fact, large doses are deleterious.

Roentgen-ray therapy is indicated for furuncles, especially those that develop in the nasal and audi-

tory canals, and on the upper lip. In the latter location, furuncles are particularly dangerous, and incisions are contra-indicated because of the character of the venous circulation directly to the base of the brain, and the hazard of serious intracranial infection.

Carbuncles seldom should be treated surgically, but rather by roentgenotherapy and other conservative measures. This statement may seem iconoclastic and heresy, especially to surgeons, but these lesions are usually draining. The natural resistances to the infection necessary for healing are enhanced by irradiation; pain is relieved, and no scarring ensues, such as must result from surgical excision.

Some acute inflammations of the eye and eyelids yield promptly to roentgenotherapy. The small doses employed will not damage the lens, but treatment should be given cautiously to young children.

Sinusitis and mastoiditis treated in the early stages usually will be aborted and the necessity for more radical procedures obviated, and lymphoid tissue in the nasopharynx that may remain or develop after adenoidectomy and tonsillectomy often will disappear following irradiation.

Acute parotitis is one of the complications which may follow operations, especially those upon the colon. The mortality rate is high. Irradiation in the early stages is effective in controlling the inflammation; it relieves the pain and fever, and has been shown to reduce the mortality rate. Roentgenotherapy usually is preferable to radium because of the ease of application; however, radium packs will be just as effective and sometimes more convenient when patients cannot be moved.

Parotid fistulae develop when Stenson's duct is severed by accident or surgical incision. A great many operations have been devised to repair the duct when severed, but they are usually unsuccessful; the drainage of saliva from these fistulae is very troublesome, especially at meal time. Almost always the gland is infected and painful. Having observed that the function of the salivary glands is suppressed by irradiation, some years ago we deliberately tried to suppress the function of the parotid gland when fistula was present, and that repeated operations had failed to cure, in order to reduce the inflammation and by stopping the production of saliva to permit the fistula to heal. In every case prompt relief of inflammation and pain has followed treatment, the drainage ceased, the fistula closed and the function returned in three or four months; and there has been normal excretion into the mouth.[1]

Probably one of the most recent developments in the use of roentgenotherapy for a specific infection has been in the treatment of gas gangrene. One of the latest reports was made by Dr. James F. Kelly,[2] who has made an intensive study of the subject. The infection by the bacillus of Welch occurs occasionally in accidental wounds; therefore, institutions with large accident services not infrequently encounter this fatal complication. Roentgenotherapy given early is almost a specific, and has reduced the mortality rate, shortened convalescence, and obviated the necessity and hazard of surgical procedures.

We have recently become interested in the treatment of the acute and subacute encephalitis, which sometimes are sequelae of measles, influenza, and other similar diseases, and also encephalitis lethargica. Roentgenotherapy for epidemic encephalitis probably was first tried with reports of benefit as early as 1929. Since then others have employed the procedure and made contradictory reports. The results of some experimental work upon animals also has been published. The chief difficulty in interpreting the results is that the clinical diagnosis is not easy, the signs and symptoms are varied and sometimes obscure, and tend to disappear spontaneously. However, patients whom we have treated have improved, in the judgment of the clinicians. The signs and symptoms, including headaches, palsies, diplopia, and even oculogyric crises, have disappeared promptly in cases in which there was reason to believe the diagnosis was correct. The various chronic forms, including Parkinson's disease, have not shown improvement.

It may be very much worth while to give roentgenotherapy to the spinal root ganglia for patients with thrombo-angiitis obliterans. One of our patients was treated over five years ago; his toes, which were gangrenous, healed, other evidences of the disease disappeared, and he has carried on his usual activities since, four months after treatment was given.

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(To Be Continued)

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WATER ABSORPTION FROM THE COLON AND ITS RELATION TO MOTILITY*

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THIS paper will bring nothing new to the physiologist, but the subject is being called to your attention, as roentgenologists, for its application in routine studies of the colon.

It is well to remember that, primarily, it is the function of the colon to remove water from the bowel residue, particularly in the proximal portion, where the content is mushy in consistency. This bowel content should have a normal p^H threshold of 7.2 and a specific gravity of water, with the water content at 70 per cent.

The colon itself, which floats in the abdomen, has both peristaltic and antiperistaltic movements, as well as churning, mixing and mass movements. The major peristaltic and antiperistaltic movements take place chiefly in the proximal bowel, and all of these actions are either enhanced or diminished by the change in the water content of that of the residue.

* Chairman's address. Read before the Section on Radiology of the California Medical Association at the sixty-eighth annual session, Del Monte, May 1–4, 1939.